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पीएलसी सिस्टम के लिए युग्मन उपकरण —  
परीक्षण के तरीके  
( पहला पुनरीक्षण )

**Coupling Devices for PLC  
Systems — Methods of Tests**  
( *First Revision* )

ICS 33.200

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Price Group 6

## FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Power System Control and Associated Communications Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

The standard was first published in 1978. This revision has been brought out to bring the standard in the latest style and format of the Indian Standards and reflect the modified references.

This standard covers methods of tests for coupling devices. Performance requirements of coupling devices are covered in IS 8997.

While preparing this standard, assistance has been derived from IEC 60481 : 1974 ‘Coupling devices for power line carrier systems’ issued by the International Electrotechnical Commission.

The composition of the Committee responsible for formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard***COUPLING DEVICES FOR PLC SYSTEMS — METHODS OF TESTS***( First Revision )***1 SCOPE**

This standard covers method of tests for coupling devices for power line carrier (PLC) systems.

**2 REFERENCES**

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards.

<i>IS No.</i>	<i>Title</i>
IS 2071 (Part 1) : 2016	High-voltage test techniques: Part 1 General definitions and test requirements

**3 GENERAL TEST CONDITIONS**

**3.1** The tests may be made at the manufacturer's works.

**3.2** The tests may be made at any ambient temperature not exceeding 50 °C. The ambient temperature during testing shall be mentioned in the test report.

**3.3** For some of the characteristics, particular measuring methods are specified. It is permissible to use alternative methods, if they are equivalent.

**4 TESTS****4.1 Classification**

The tests shall be classified according to **4.1.1**, **4.1.2** and **4.1.3**.

**4.1.1 Type Tests**

The following shall constitute type tests and shall be carried out in the sequence given below:

- Composite loss (**4.2**);
- Return loss (**4.3**);
- Distortion and intermodulation test (**4.4**);
- Impulse-voltage test (**4.5**);
- Tests on arresters (**4.6**);
- Power frequency voltage test (**4.7**); and
- Tests on drain coil and matching transformer winding (**4.8**).

**4.1.1.1 Samples for type tests**

Type tests shall be applied to 3 specimens. In the event of any one specimen failing to comply with the requirements in any respect, a further set of 3 specimens shall be taken all of which shall comply with the requirements of the standard.

**4.1.2 Acceptance Tests**

The following shall constitute acceptance tests and shall be carried out in the sequence given below:

- Composite loss (**4.2**);
- Return loss (**4.3**); and
- Power frequency voltage test (**4.7**).

**4.1.2.1 Sampling plan for acceptance tests**

A recommendatory sampling plan is given in Annex A.

**4.1.3 Routine Tests**

The following shall constitute routine tests and shall be carried out in the sequence given below:

- Composite loss (**4.2**),
- Return loss (**4.3**), and
- Power frequency voltage test (**4.7**).

**4.2 Composite Loss**

Measurement of the composite loss shall be carried out at several frequencies within the available bandwidth of the coupling device. The coupling capacitor(s) shall be replaced by one or two test capacitance of the coupling capacitor(s).

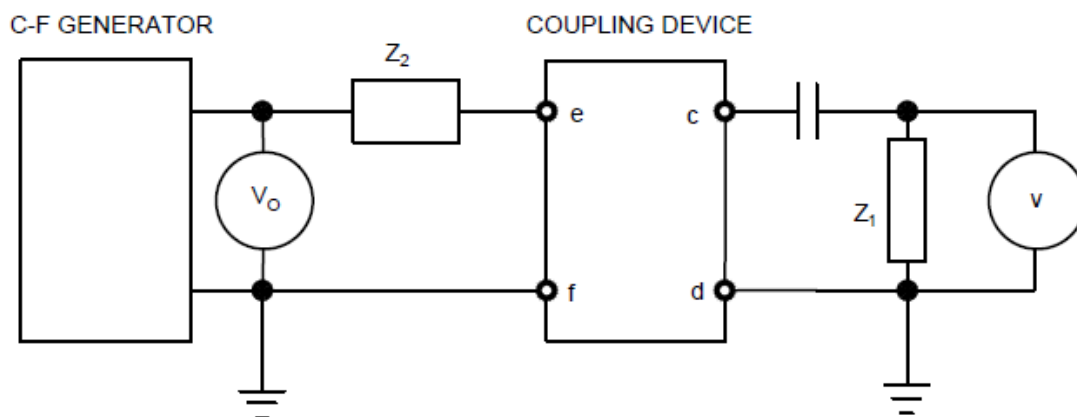
Fig. 1 shows one method of measuring the coupling device composite loss  $A$ , which is given by the formula:

$$A_C = 20 \log_{10} \frac{V_0}{2V} \sqrt{\frac{Z_1}{Z_2}} \text{ (dB)}$$

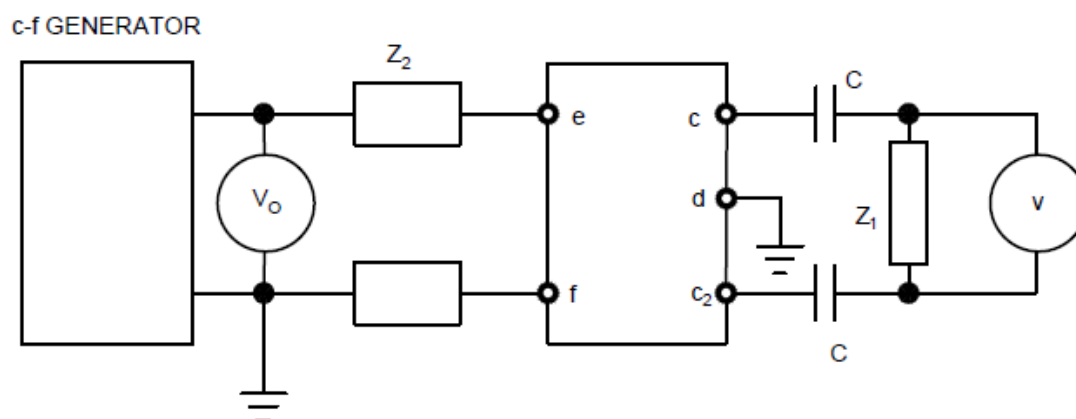
Where  $\&$  and  $\$$  are equal to the nominal line-side and equipment-side impedances, respectively, and voltages  $V_0$  and  $V$  are the values indicated by the voltmeters.

**4.3 Return Loss**

Measurement of the return loss shall be made at several frequencies within the available bandwidth of the coupling device. The coupling capacitor(s) shall be replaced by one or two test capacitors having negligible loss and a capacitance equal to the nominal capacitance of the coupling capacitor(s).



1A MEASUREMENT ON PHASE- EARTH COUPLING DEVICE WITH UNBALANCED SECONDARY CIRCUIT



1B MEASUREMENT ON PHASE- EARTH COUPLING DEVICE WITH UNBALANCED SECONDARY CIRCUIT

*Key*

- $C$  = capacitance of the coupling capacitor;
- $V_u, V$  = high impedance voltmeters;
- $C, C_1, C_2$  = primary terminals of coupling device;
- $J$  = switch;
- $d$  = earth terminals of coupling device; and
- $e, f$  = secondary terminals of coupling device.

NOTES

1 See Fig. 1A of IS 8997 : 1987\* for complete explanations.

2 In the case of a balanced secondary circuit, it is necessary to interpose between resistor  $Z_2$  and the coupling device a balanced transformer having ratio 1 : 1 the centre of the winding of the coupling device side is connected to earth.

FIG.1 MEASUREMENT OF THE COMPOSITE LOSS

Fig. 2 shows one method of measuring return loss. Return loss A is given by the formula:

$$A = 20 \log_{10} V/V'' \text{ (dB)}$$

where

V' and V'' are the voltages measured by voltmeter V with switch 3 in the 'on' and 'off' position, respectively, the generator voltage V, being kept equal in both switch positions.

#### 4.4 Distortion and Intermodulation Test

This test can be carried out by applying to the secondary terminals of the coupling device, two generators, set on two different frequencies conveniently located within the available bandwidth of the coupling device, so that, across an impedance equal to the nominal line-side impedance connected to the primary terminals by means of the test capacitor(s), two equal signals are obtained whose power is equal to one-quarter of the nominal peak-envelope power. Under these conditions, measurements of any distortion or intermodulation products can be made using a selective measuring set with an effective bandwidth not exceeding 300 Hz. The test should be carried out in such a manner as to simulate, as closely as possible, the products operating conditions of the coupling device in service, including the effect of the power-frequency current normally flowing through the coupling device.

**4.4.1** Due to difficulties which are likely to arise in carrying out the test, alternative methods may be agreed upon between manufacturer and purchaser.

#### 4.5 Impulse-Voltage Test

The impulse-voltage test on phase-to-earth coupling devices shall be performed in accordance with the

diagram given in Fig. 3A, after disconnecting the arresters.

The same procedure shall be followed for phase-to-phase coupling devices (*see* Fig. 3B) by applying the impulse voltage to one terminal and repeating the same test on the other terminal afterwards. The no connected terminal shall remain isolated. Ten 1.2/50  $\mu$ s voltage impulses shall be applied in sequence, five negative and five positive, in accordance with IS 2071 (Part 1) at 10 kV (peak). After this, carrier frequency tests shall be repeated, namely, composite loss and return loss.

#### 4.6 Tests on Arresters

The tests on arresters shall be carried out under a procedure agreed upon between manufacturer and purchaser.

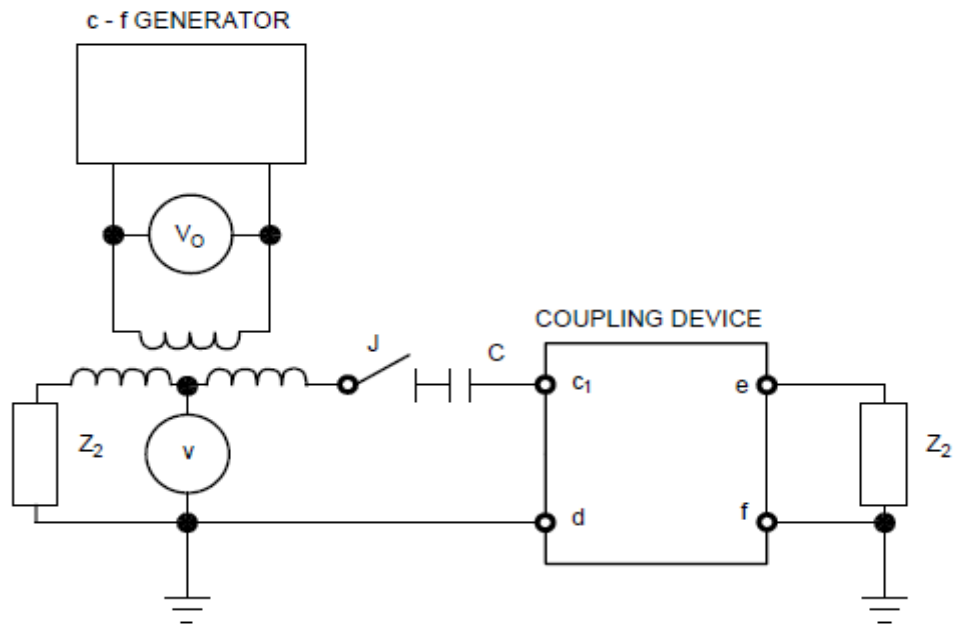
#### 4.7 Power Frequency Voltage Test

If galvanic isolation is provided by a transformer, then the tests described in Fig. 4, shall be carried out, applying for one minute a power frequency voltage of the specified value between each coil in turn and earth, the other winding and screen, if present, being connected to earth.

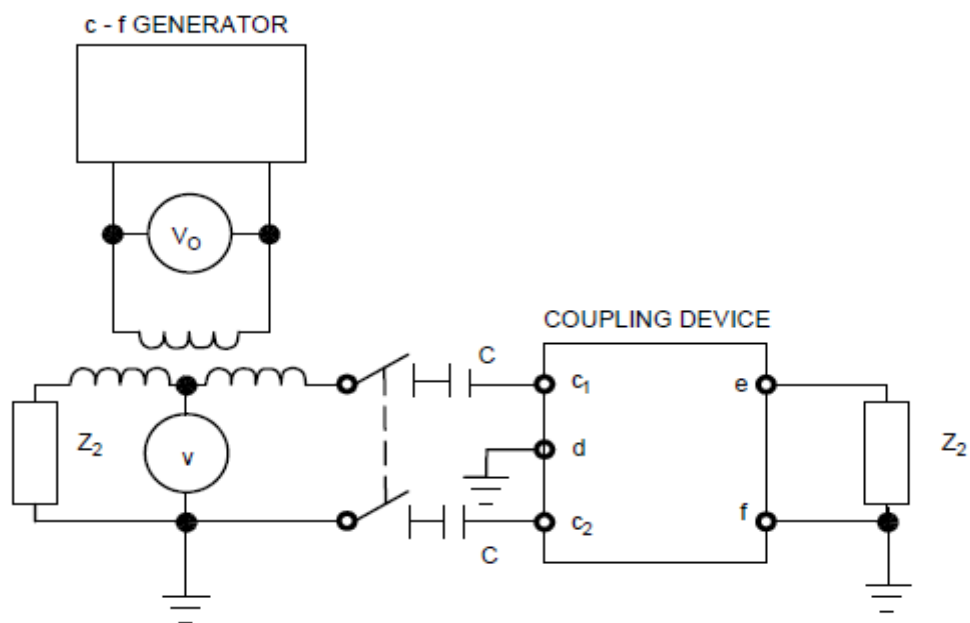
#### 4.8 Tests on Drain Coil and Matching Transformer Winding

These tests shall include:

- a) Measurement of the impedance at power frequency; and
- b) Current-carrying capacity at power frequency:
  - 1) Permanent current 1 A (rms); and
  - 2) Short-time current 50 A (rms) for 0.2 s.



2 A Measurement on Phase - Earth Coupling Device with Unbalanced Secondary Circuit



2 B Measurement on phase - Phase Coupling Device with Unbalanced Secondary Circuit

Key

$C$  = capacitance of the coupling capacitor;

$f$  = switch; and

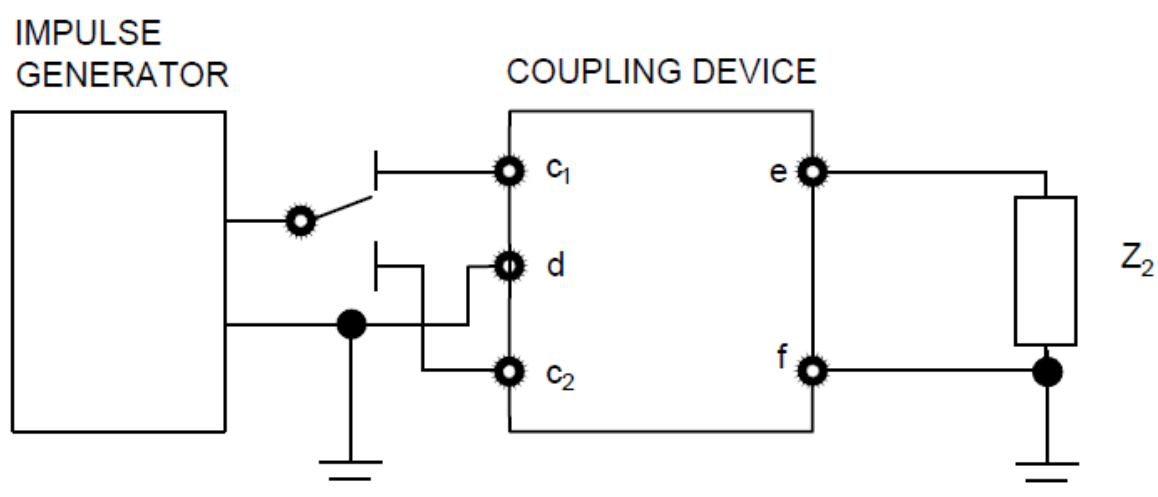
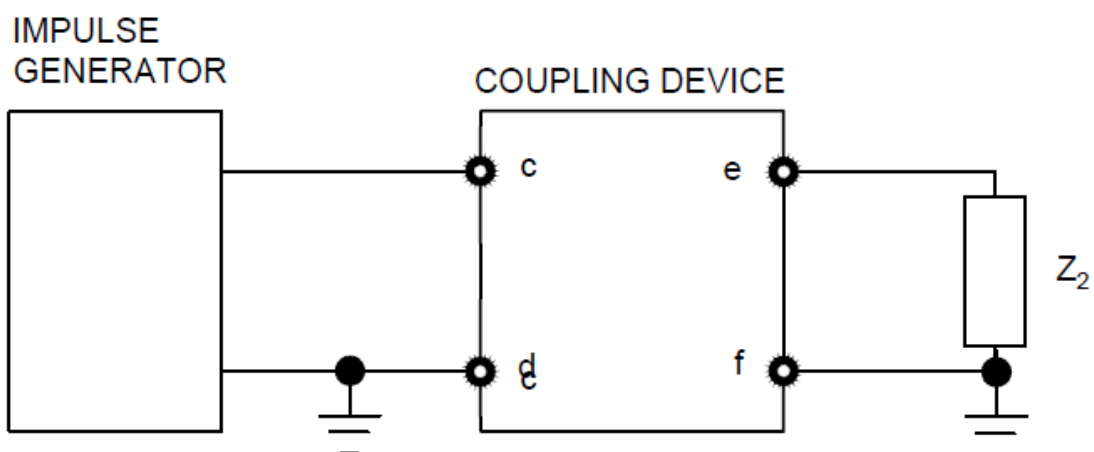
$V_O, V$  = high impedance voltmeters.

NOTES

1 See Fig. 1A for explanations.

2 In the case of a balanced secondary circuit, it is necessary to connect earth of the centre of the resistor  $Z_2$  instead of terminal  $f$ .

FIG. 2 MEASUREMENT OF RETURN LOSS

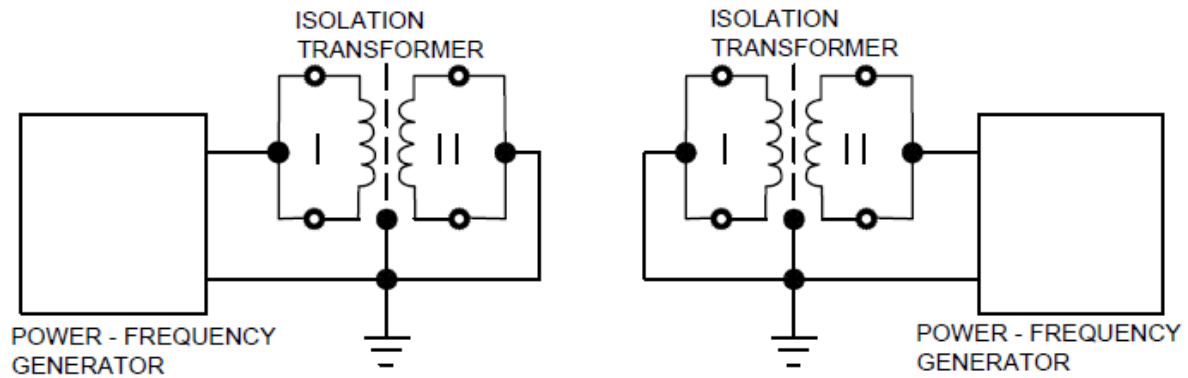


## NOTES

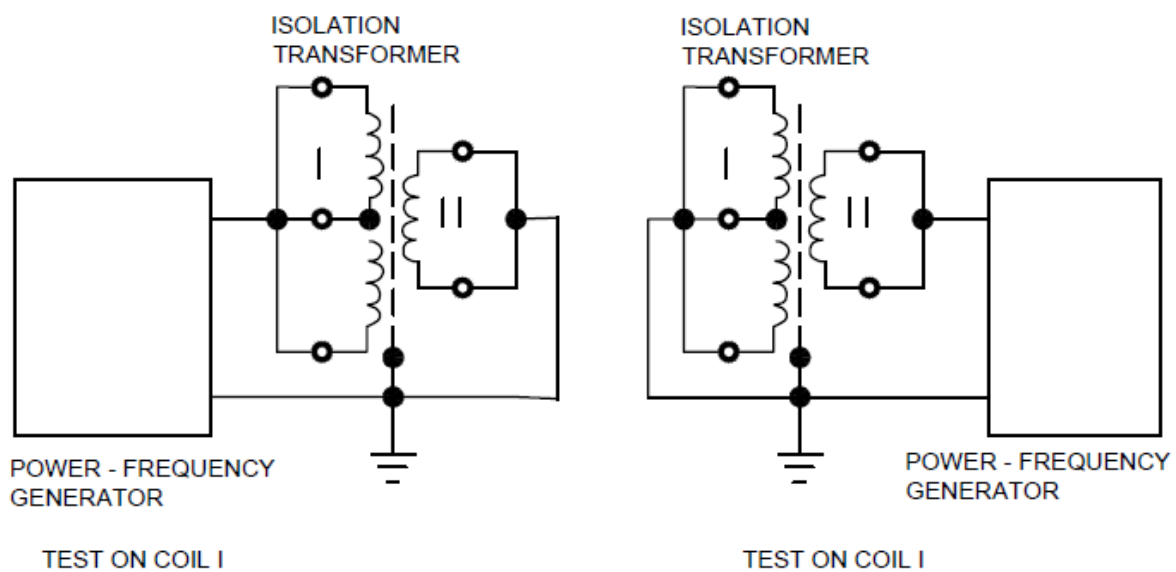
1 See Fig. 1 for explanations

2 In the case of balanced circuit, the earth shall be connected to the centre of resistor  $Z_2$  instead of terminal  $f$ .

FIG. 3 IMPULSE VOLTAGE TEST OF COUPLING DEVICE



4A Test on Isolation Transformer for Phase- Earth Coupling Device



4B Test on Isolation Transformer for Phase - Phase Coupling Device

I = Primary coil (line side )

II = Secondary coil (equipment side )

FIG. 4 POWER-FREQUENCY TEST ON ISOLATION TRANSFORMER

**ANNEX A**

(Clause 4.1.2.1)

**RECOMMENDED SAMPLING PLAN****A-1 LOT**

**A-1.1** All the coupling devices of the same type and manufactured under similar conditions shall be grouped together to constitute a lot.

**A-1.1.1** Samples shall be taken and tested from each lot for ascertaining the conformity of the lot.

**A-2 SCALE OF SAMPLING**

**A-2.1** The number of coupling devices to be taken shall be in accordance with col (1) and col (2) of Table 1. These coupling devices shall be taken at random (*see* IS 4905).

**A-3 Number of Tests and Criteria for Acceptance**

**A-3.1** The coupling devices taken in accordance

with col (1) and col (2) of Table 1 shall be tested for acceptance tests. If a coupling device fails in any one of the acceptance tests, it shall be called a defective.

**A-3.1.1** If the number of defectives observed is less than or equal to the permissible number of defectives given in col (3) of Table 1, the lot shall be considered as conforming to the acceptance tests, otherwise not.

**A-3.1.2** If the lot is rejected (*see* **A-3.1.1**), each coupling device in the lot shall be tested for each of the acceptance tests, and only those coupling devices which pass all the acceptance tests shall be accepted.

**Table 1 Scale of Sampling and Permissible Number of Defectives**

(Clause A-2.1)

Sl No.	Lot Size	Sample Size	Permissible Number of Defectives
(1)	(2)	(2)	(3)
i)	Up to 50	20	0
ii)	51 to 150	32	0
iii)	151 and above	50	0

NOTE — whenever the lot size is 20 or below, all the coupling devices in the lot shall be tested.

**ANNEX B***(Foreword)***COMMITTEE COMPOSITION**

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### Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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